

fighters can get to their attack positions and the range from which they attack are crucial. Also important is "loiter time"--the time the plane can remain aloft--since in high-threat situations the Navy keeps some of its fighters on continuous alert, flying combat air patrol some distance from the carrier.

As with fleet air defense, the targets of the counterair mission are also airborne, but they would more likely be either enemy fighters or strike aircraft that would endanger ground forces rather than attack ships.^{1/} Since a counterair battle might be fought at closer ranges than are typically expected in fleet air defense, fighter aircraft designed for counterair attacks emphasize both maneuverability and speed.

Strike Warfare

Strike aircraft attack enemy surface targets, such as ground forces and ships, and are the major offensive forces among naval aircraft. Strike aircraft, also called attack aircraft, can be divided into two categories, medium and light, depending on how many pounds of bombs (or "payload") the plane can carry.

Range and payload are important in the design of aircraft for this mission. The longer the range of the attack aircraft, the farther away from a target the carrier can remain or the deeper into enemy territory the plane can bomb, though aerial refueling can extend the ranges of aircraft. (The availability of tankers for aerial refueling may be limited, however, depending on how many carriers are involved in the engagement and how many missions are being pursued at once.) A plane with higher payload is likely to do more damage each time it is sent out. Also important is the ability to hit targets with precision and to survive, either by being less visible to enemy sensors or by maneuvering to evade enemy surface-to-air missiles and enemy fighters. Some strike aircraft for the Marine Corps also emphasize vertical or short takeoff capability in order to provide air power in the absence of airfields, in cases where those

1. The counterair mission is also performed by strike aircraft--short- and medium-range bombers (discussed later)--when they attack aircraft on the ground and air base facilities.

fields have been damaged, or for operating from amphibious ships in support of forces ashore.

Antisubmarine Warfare

The Navy's antisubmarine warfare (ASW) mission employs several kinds of planes and helicopters as well as surface ships and attack submarines to detect, locate, and destroy enemy submarines. The aircraft have a variety of sensing devices to detect submarines, though the primary devices are acoustic because sound waves are transmitted particularly well by water. ASW aircraft also contain extensive computer resources to transform the data provided by the acoustic devices into usable and timely information. These aircraft must also have extended ranges and long loiter times in order to remain in an area where a submarine has been detected long enough to fix its position and attack it.

Electronic Warfare

The capabilities of the above-mentioned forces are considerably enhanced if they have adequate knowledge about the size, capability, and locations of the enemy; can receive timely commands; and can communicate with each other and with other portions of the battle group. Similarly, the capabilities of enemy forces are degraded if such information can be withheld from them. Electronic warfare (EW) aircraft perform these missions.^{2/} They detect and track enemy targets and provide airborne battle management. They also provide electronic jamming, which reduces the electronic "vision" of enemy forces, and a barrage of electronic noise to cover attacking strike forces.

Amphibious Assault

The Marine Corps expects to make extensive use of helicopters and fixed-wing aircraft in future amphibious operations. Along with

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2. For the sake of simplicity, the mission of detecting and keeping track of enemy forces has been subsumed under electronic warfare. More typically, the term "electronic warfare" is used by the tactical aircraft community to describe the jamming mission, whereas tracking enemy forces and relaying their locations to friendly forces is called command, control, and communications.

landing craft, aircraft will be used to transport troops and supplies ashore--a strategy called vertical envelopment. Aircraft would be critical in meeting the Marine Corps' goal of moving the assault elements of a Marine amphibious force and a Marine amphibious brigade--or about 11,000 combat troops with their supporting vehicles, artillery, and supplies--ashore within 90 minutes.

The Marine Corps expects to have an amphibious mission in a future war even though the most likely adversary--the Soviet Union--is not an island power as was Japan in World War II. In a future war, amphibious missions could be important for protecting the North Atlantic Treaty Organization's (NATO's) northern flanks around Norway or for protecting its southern flanks in the Mediterranean area.^{3/} The Marine Corps also argues that it might attempt to divert Soviet attention through assaults on Soviet strongholds in eastern Russia. And if war occurred in Southwest Asia, amphibious missions could take place in the vicinity of the Straits of Hormuz. Amphibious missions could also take place in the South China Sea, south of Thailand, in an effort to keep straits open for transport of Mideast oil to U.S. allies in Asia.

AIRCRAFT

To accomplish these many and diverse missions, the Navy and Marine Corps have about 3,650 active and reserve combat aircraft. The aircraft are organized into 14 active Navy air wings and 3 wings in the active Marine Corps. An additional reserve Marine Corps wing and 2 naval reserve wings would augment or reinforce these forces in war. (Reserve wings train only part-time in peacetime.) A Navy air wing

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3. The Marine Corps intends to preposition the items associated with a Marine amphibious brigade that would be most difficult to move rapidly in a conflict in Norway. As of September 1987, about 43 percent of the items will be in place in central Norway near Trondheim. Marine forces would be expected to augment Norwegian and other NATO forces to prevent the Soviet Union from taking Norway. Should the Soviets take Norway, the Navy and others have argued, convoy traffic to the United Kingdom would be seriously endangered, because sea lines of communication--now only within range of Soviet bomber aircraft--could be attacked by shorter-range Soviet attack aircraft. Norway's mountainous terrain is less amenable to heavy forces, and the Soviet strength there might be less; hence, the lighter forces of the Marine Corps might have an advantage in this area.

usually consists of about 86 aircraft; a Marine Corps wing has about 310 aircraft. The inventory also includes aircraft associated with ASW forces based on land and surface combatants. In addition to aircraft assigned to these forces, other aircraft are used for training and research, and some planes are in repair.

The Navy has at least 16 major types of combat aircraft.^{4/} The discussion below describes the types most important in this study, organized by mission. Table 1 lists all the types and their primary and secondary missions.

Fleet Air Defense and Counterair Aircraft

Navy and Marine forces contain three kinds of aircraft that perform the fleet air defense or counterair mission--F-14, F/A-18, and F-4. The F/A-18 and the F-4 also perform strike warfare as a primary mission.

F-14 Tomcat. The F-14 is the premier air defense aircraft in the U.S. inventory. A twin-engine, two-seat, supersonic airplane, it can move its wings during flight to optimize its airfoil configuration for different parts of its flight regime. During subsonic flight, and especially during carrier landings when the capacity to stay aloft at comparatively slow speeds is important, the wings are spread to provide the maximum lift. During supersonic flight, the wings are swept back to provide the least drag or resistance to the air. The Tomcat is also the only U.S. plane capable of carrying the long-range Phoenix missile, which can fire at targets from distances of about 80 miles.

The Navy will have bought 583 F-14As through 1988 and plans to procure 55 F-14Ds (a new model) over the five-year period from 1988 to 1992. Consistent with its capability, the F-14D is expensive, with a

4. Much of the technical detail in this chapter was taken from *Jane's All the World's Aircraft* and *Jane's Weapon Systems* (London, England: Jane's Publishing Company), various editions. Some performance details may represent optimum conditions rather than performance in normal combat situations. Cost data are from the President's budget for fiscal years 1988 and 1989.

TABLE 1. NAVAL AIRCRAFT AND THEIR MISSIONS

Fleet Air Defense	Strike Warfare	Antisubmarine Warfare	Electronic Warfare	Amphibious Assault
Primary Mission				
F-14	F/A-18	P-3	E-2	CH-46
F-4	A-6	S-3	EA-6	CH-53
F/A-18	AV-8	SH-2	ES-3	V-22
	F-4	SH-3		AH-1
	A-4	SH-60B		
		SH-60F		
Secondary Mission				
AV-8 <u>a/</u>	F-14	F-14	F-14	---
		A-6	F/A-18	
		F/A-18	P-3	
		V-22 <u>b/</u>	S-3	

SOURCE: Congressional Budget Office from Department of the Navy sources.

- a. The Marine Corps indicates that the AV-8 could be used to defend amphibious task forces in emergencies.
- b. The Navy is currently considering candidates to replace the S-3 in its ASW mission. The V-22 is considered a candidate.

projected average unit price tag of about \$74 million.^{5/} (Unless otherwise noted, aircraft costs discussed in this section represent total unit procurement costs from 1988 through the remainder of the program, expressed in 1988 dollars).

F/A-18 Hornet. The Hornet is a single-seat, twin-engine, supersonic airplane, capable of performing air defense and counterair plus the strike or attack mission. The plane was selected by the Navy in 1975 as its "low mix" (less capable and cheaper) fighter/attack aircraft. It lacks both the F-14's ability to carry long-range missiles and the long-

5. A cost of \$74 million reflects the cost of new procurement only and was chosen to be consistent with the costs of other planes discussed in this and later sections. The Navy argues that the correct average procurement unit cost for the F-14D program should be about \$35 million, reflecting the lower cost of 400 F-14As that will be remanufactured to F-14Ds at the same time the new planes are being built.

range and other capabilities of the A-6 (discussed later). The F/A-18 is, however, substantially cheaper than the F-14, costing \$26.4 million each. The Navy has bought 577 F/A-18s and plans to procure 372 more for itself and the Marine Corps over the next five years.

F-4 Phantom. Originally developed in the 1950s, the F-4 has undertaken many of the fighter/attack missions of the Navy and the Marine Corps as well as the Air Force. The Navy and Marine Corps now have about 120 of these aircraft, averaging 18 years of age. The Navy is rapidly phasing out the two-seat, twin-engine, supersonic plane from its inventory, and all should be gone by 1991.

Strike Aircraft

Five types of aircraft perform the Navy's strike or attack mission of bombing surface targets, three of which are still in production. The A-6 and the AV-8 are described here; the F/A-18 was described above.^{6/}

A-6 Intruder. The Navy's medium-attack aircraft, the A-6, is a two-seat, twin-engine, subsonic airplane that has the electronic equipment to attack surface targets at night and in bad weather.^{7/} The A-6 also has longer unrefueled ranges and larger payloads than the Navy's other attack aircraft. The A-6 was first introduced into the fleet in 1963 and is still being bought despite concerns about its capabilities. Experience in Lebanon in 1983, when an A-6 attempting to bomb a terrorist stronghold was shot down, contributed to concerns about the survivability of the A-6 against modern defenses. The A-6 lacks the speed and maneuverability to evade enemy defenses if it is detected,

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6. The Navy usually divides the bombing missions into two categories-- attacking ships and attacking land targets. The term strike mission is commonly used to describe only the latter.
 7. Carrier battle groups and Marine forces have only light- and medium-attack assets. Heavy-attack assets intended primarily for nuclear attack are now the exclusive province of the Air Force. This change in Naval policy in the 1950s reflected the Navy's concern that improvements in strategic defense might make these missions difficult to accomplish within weight and payload constraints associated with designing planes to take off from and land on carriers, and that more likely wartime scenarios for the future were smaller conventional conflicts.

and cannot defend itself against enemy aircraft. Nonetheless, the A-6 will be in the inventory for many more years, and so it is being modified to increase its survivability; it will receive a new radar, enhanced avionics, and a new kind of engine.

AV-8B Harrier. The Harrier is a Marine Corps aircraft that has one jet engine and a single seat. It can take off vertically, like a helicopter, or from very short runways or amphibious ships by vectoring engine exhaust toward the ground. The AV-8B Harrier is used by the Marine Corps for air support in close proximity to friendly troops and is replacing the older A-4 aircraft and an earlier, less capable version of the Harrier, the AV-8A. The Harrier is also capable of firing heat-seeking air-to-air missiles.

Antisubmarine Warfare Aircraft

The Navy has two types of fixed-wing aircraft (the P-3 and S-3) and four helicopters (SH-3, SH-2, SH-60B, and SH-60F) that it uses to detect and destroy enemy submarines. The propeller-driven P-3 flies from land bases and uses its long range and extended time on station ("loiter time") to cover wide areas. The S-3 is a carrier-based jet aircraft that provides protection at long ranges from the carrier battle group. The four helicopters are based on carriers and surface combatants and provide protection closer to the carrier battle group.

Electronic Warfare Aircraft

This family of aircraft provides command, control, and communications to the carrier battle group and actively supports the battle group's activities by providing electronic jamming. The carrier-based E-2 is an airborne listening post that would loiter above the battle group, provide information to the forces about target location, and guide forces to attack enemy forces. The E-2C is a two-engine, turbo-prop plane with a crew of five. It can detect airborne targets anywhere within an area of 3 million cubic miles and can track more than 600 targets and control 40 airborne intercepts.^{8/} E-2s can also track ships

8. *Jane's All The World's Aircraft.* These figures may represent optimum conditions.

and can detect small airborne targets like cruise missiles. Reflecting its extensive capabilities, the E-2C is one of the more costly naval aircraft, at about \$65 million each. The EA-6 is a variant of the A-6 and performs tactical jamming to baffle enemy radars. The ES-3 is a modified S-3 that the Navy plans for an electronic battle group support mission.

Amphibious Assault Aircraft

The amphibious assault mission--moving troops and equipment to assault a beachhead--is performed by two Marine Corps helicopters, the CH-46 and the CH-53. The CH-46 is a medium-lift helicopter that can carry 17 troops or 4,200 pounds of equipment. The primary mission of the CH-53E is transporting heavy cargo from ship to shore--the heavy-assault mission. Though one version, the CH-53E, can carry up to 55 troops or 32,000 pounds of cargo, the Marine Corps states that it would be limited to no more than 30 troops, because of its vulnerability to ground fire and also to lessen the impact of the loss of one helicopter. Both the CH-46 and CH-53 are unarmed.

A third helicopter, the AH-1, provides combat fire support to the amphibious assault. This helicopter, which is also found in Army inventories, carries guns and missiles for attacking enemy troop positions and armored vehicles.

New Aircraft

The Navy intends to begin two new aircraft procurement programs during the coming five-year period--the Long-Range Air ASW Capable Aircraft (LRAACA) and the V-22 medium-assault aircraft. Procurement of both programs is scheduled to begin in 1990, and their inclusion in the aircraft procurement account contributes so substantially to costs that funding is scheduled to grow by almost 20 percent in real terms over 1989.

The LRAACA is supposed to be either a more austere and less expensive variant of the P-3 or a more expensive variant of a commercial aircraft that, having longer endurance, could be bought in smaller quantities. The LRAACA must be a variant of some existing

plane, since the three-year development period does not allow enough time to produce a new aircraft.^{9/} Navy estimates of funds for the plane would indicate an average cost of about \$46 million, or roughly \$6 million less than the average P-3C cost (over the life of the P-3C program from 1983 to 1987).

The V-22 (still widely known as the J VX) is a new tilt-rotor aircraft that will eventually replace the CH-46 in performing the Marine Corps' medium-assault mission. The V-22 will take off and land like a helicopter, or it can make short rolling takeoffs to increase range and payload. In flight it will flip ("tilt") its rotor assemblies into a horizontal position and will function like a fixed-wing aircraft. While the Army and Air Force have also indicated requirements for these planes, the Marine Corps has the earliest and largest requirement. The Navy may also be considering a variant of the V-22 for antisubmarine warfare. Current program estimates for the V-22 indicate a unit cost of about \$25 million, or about four times the original procurement cost (in 1988 dollars) of the CH-46 it is to replace, though the Marine Corps argues that it will also provide substantial improvements in speed, range, and survivability.

The Navy also plans a new plane to replace its A-6 attack aircraft, though apparently not until the mid-1990s. This plane, currently designated the Advanced Tactical Aircraft (ATA), is expected to be stealthy--that is, less visible to enemy sensors. Official details about the cost and other features are not available. Chapter V discusses what is publicly known about the aircraft.

STRATEGY

Naval aircraft, the Administration argues, would play a key wartime role in attacking enemy forces and bottling up Soviet naval forces that

9. The Navy released the request for proposal (RFP) for the LRAACA this fall. Informal sources indicate that Boeing, Lockheed-California, McDonnell Douglas, and Gulfstream Aerospace expressed interest in participating. Apparently the Navy specified its requirements in terms of the capabilities required for the fleet of aircraft rather than specifying a minimum number of planes bought, thus enabling companies to propose more capable aircraft that are more expensive but may be able to perform the mission in smaller quantities.

could otherwise attack friendly ships. Some analysts, however, disagree about the usefulness of naval aircraft and question the reasonableness of the Navy's plans for deployment of aircraft carriers. Although different issues are raised about Navy and Marine Corps aircraft, the issues surrounding both are contentious.

Navy Aircraft

Most of the issues surrounding Navy aircraft relate to the utility of aircraft carriers, both in peacetime and in a major war.

Peacetime and Minor Conflicts. In peacetime, the U.S. Navy keeps about four or five aircraft carriers deployed overseas at all times. Deployments vary with world events, but a typical recent deployment saw two carriers in the Mediterranean Sea, one or two near Japan, and one outside the Persian Gulf. The carriers are there to make foreign countries aware of U.S. military capability--that is, to "show the flag." They may also participate in minor hostilities. For example, some of the aircraft that attacked Libya in 1985 flew off carriers; carriers also supported the invasion of Grenada in 1983. In addition, the Navy has continuously deployed two or three amphibious ready groups (that is, forward-deployed amphibious task forces) to the Mediterranean and the Western Pacific. One such group participated in the 1983 Grenada invasion. Marine helicopters and AV-8s normally operate from these amphibious ready groups.

In conflicts that are more than minor but do not directly involve the Soviet Union, aircraft carriers may not face significant threats. In such cases they can operate as floating air bases, launching strikes against land targets. During the Vietnam War, for example, the United States typically brought its carriers to within 100 miles of the Vietnamese coast because North Vietnamese forces posed no significant threat to them. Carrier aircraft were thus able to operate at significantly shorter ranges than were land-based aircraft, which typically operated from bases in Thailand. The advantages of aircraft carriers were also exemplified by the extensive early employment of carrier-based aircraft while airfields were being built.

Few analysts question the utility of having some aircraft carriers deployed in peacetime and minor hostilities. When they face little

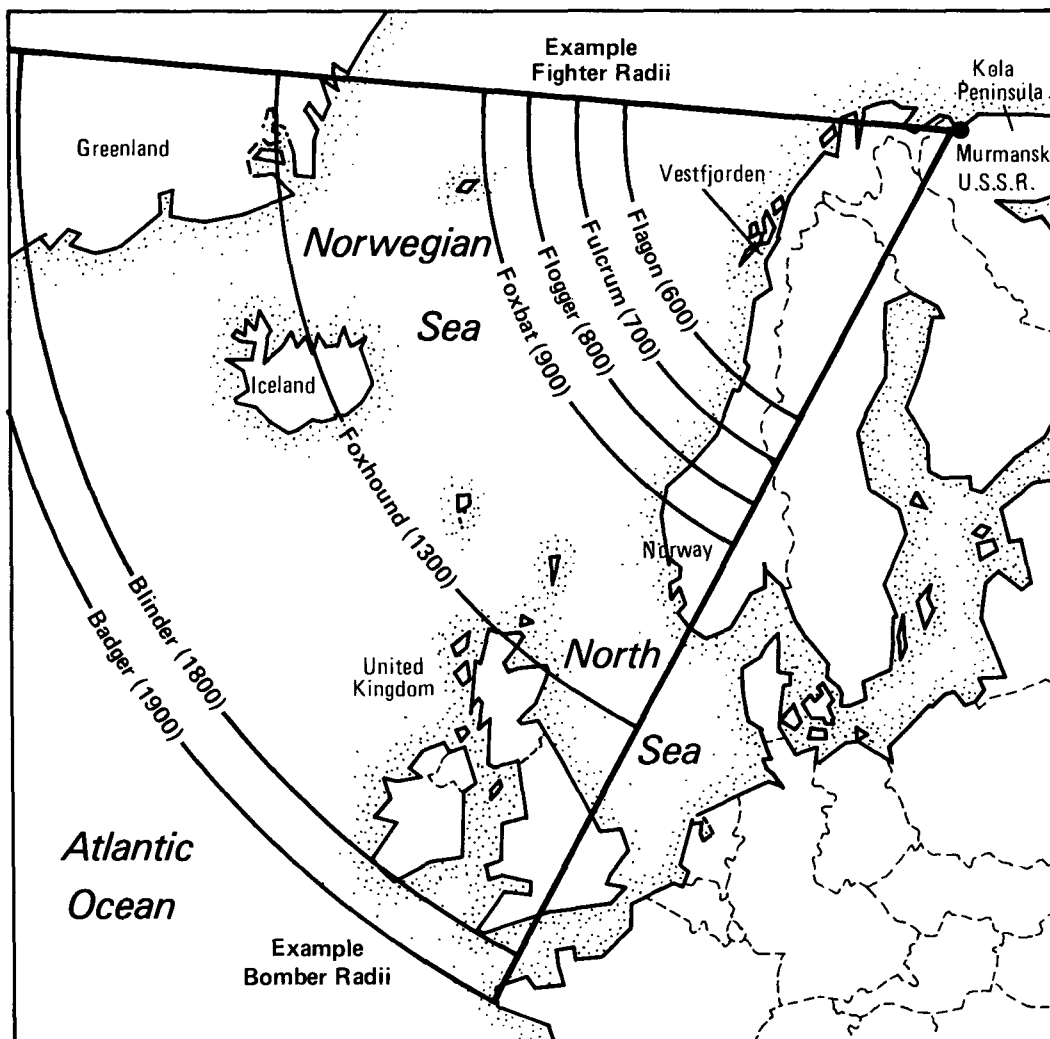
opposition, aircraft carriers allow the United States to display airborne military capability without depending on landing rights in foreign countries. Indeed, naval forces--including airborne forces--have been by far the most frequent choice of U.S. policymakers during periods of tension. The Navy has said that its forces have taken part in more than 80 percent of the crises confronting the United States since 1946.

While the need for some carriers is widely accepted, the need for the United States to keep four or five carriers constantly deployed overseas during peacetime is not. This issue has important budget implications, since peacetime deployments influence the number of carriers that are needed and hence the needs for aircraft (though they do not determine the quality of the required aircraft). The Navy feels that three carriers are needed to keep one deployed continually. Critics argue that the United States could follow a policy of "surge" deployments--that is, limiting peacetime deployments, but then augmenting the number of carriers in a key region when events warranted such action. The Navy counters by noting the difficulties of getting forces to distant areas--particularly areas like the Persian Gulf--quickly enough in the face of rapidly changing world events. To date, several presidents have chosen to keep four or five aircraft carriers deployed overseas in peacetime, indicating that that number may be decided at higher policy levels than the Navy.

Some critics have questioned the Navy's 3-to-1 ratio, arguing that peacetime deployments have been at current rates even in times when the Navy's carrier force was smaller. The Navy counters that this situation places undue stress on Navy personnel and may contribute to problems in retaining manpower.

Major War. Concerns about carriers' capabilities in a major war are more pronounced. In a war against the Soviet Union, carrier battle groups--together with U.S. attack submarines--would be the vanguard of the so-called forward offensive strategy. Under this strategy, naval forces would attempt to gain control in the northern Norwegian Sea and might attempt to strike Soviet forces based on or near the Kola peninsula north of Norway (see Figure 1 for a description of this area). Carriers might also assist Marine forces in the mission of defending northern Norway from Soviet attack. The Navy intends such a

Figure 1.
Examples of Radii of Unrefueled Soviet Bombers and
Fighters from the Kola Peninsula



SOURCES: Congressional Budget Office estimates from radius data presented in Department of Defense, *Soviet Military Power* (1985); deployment data in International Institute for Strategic Studies, *The Military Balance 1985-1986* (Letchworth, England: Garden City Press, Ltd., 1985); and information from Soviet Studies Research Centre, RMA Sandhurst, *Soviet Amphibious Warfare and War on the Northern Flank* (The Hague, The Netherlands: SHAPE Technical Centre, December 1984).

NOTE: Radii—the distance a plane can reach and still have fuel to return to base—are listed in statute miles. Radii are intended to be approximations and are subject to substantial variations depending on a variety of assumptions including flight profile, refueling, and flight path. The exact nature of Soviet deployments or plans to redeploy to this area are unknown; planes in the example were chosen because they are listed in *The Military Balance* as having responsibility for the Kola area.

strategy to force the Soviet Union either to withhold forces that might otherwise be used to attack sea lines of communication (where convoys resupplying friendly forces would transit) or to assist in the central European battle in order to attack Norway, defend the Soviet homeland, and protect Soviet ballistic missile submarines (SSBNs) that carry strategic nuclear missiles.^{10/} Soviet naval doctrine states that protecting the SSBNs is the Soviet Navy's most important task.

U.S. naval forces would also pursue a forward strategy in the area of the Kamchatka peninsula in the northern Pacific and in Vladivostok in the Sea of Japan, the other location for Soviet SSBNs. The desire for simultaneous forward deployments in these areas, together with several other flanking attacks, drives the Navy to its goal of 15 carriers.^{11/} Navy plans for these carrier deployments are shown in the table below.

	Navy Estimates of Carrier Requirements (By fleet)	
	Peacetime	Wartime
Sixth Fleet (Mediterranean)	1.3	4
Second Fleet (Atlantic)	6.7	4
Seventh Fleet (W. Pacific)	2	5
Third Fleet (E. Pacific)	<u>5</u>	<u>2</u>
Total	15	15

Figures for the Second and Third Fleets include forces in overhaul; figures for the Seventh Fleet include forces in the Indian Ocean.

Critics assert that carriers fighting near the Soviet homeland, within range of Soviet land-based aircraft, may be too vulnerable.

10. Admiral James D. Watkins, USN, "The Maritime Strategy" (U.S. Naval Institute, Annapolis, Md., January 1986), pp. 2-17.

11. John F. Lehman, Jr., "The 600-Ship Navy" (U.S. Naval Institute, Annapolis, Md., January 1986).

Using the Norwegian Sea forward strategy as an example, a recent study by the Brookings Institution posits losing as many as eight or nine carriers, depending on the number committed to the strategy.^{12/} Indeed, as Figure 1 shows, moving a carrier within striking range of Murmansk would also bring it within range of an extensive array of Soviet forces. A carrier battle group sailing as far north as Vestfjorden in northern Norway, for example, could come under attack by land-based Soviet naval aviation bombers--from 85 to about 250 planes in the Northern and Baltic fleets.^{13/} At this range, Soviet bomber forces could be accompanied by about 270 Soviet fighters and interceptors in this area.^{14/} And a greater number of Soviet attack submarines and surface combatants might be encountered this far north. The recent mining of the Persian Gulf by Iran may suggest an additional problem--that of finding and destroying mines--if the Soviet Union chose to mine these northern waters.

The Navy counters that it will be able to defend the carriers, using the strategy of defense in depth. The attacking Soviet aircraft will be met at long ranges by counterair aircraft based on the carriers. The attacking aircraft that avoid these counterair aircraft, and any enemy missiles that are launched, will be attacked by ships defending the carriers, including the new Aegis cruiser with its highly sophisticated defensive systems. Similar defense in depth is planned for attacks from enemy submarines.^{15/}

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12. William Kaufman, *A Thoroughly Efficient Navy* (Washington, D.C.: Brookings Institution, 1987), p. 130.
 13. The higher numbers in this wide range of estimates come from Congressional Research Service, *U.S.-Soviet Military Balance 1980-1985* (1985). The lower numbers come from International Institute for Strategic Studies, *The Military Balance 1985-1986* (Letchworth, England: Garden City Press Ltd., 1985). The range may result, at least in part, from differing views of the likely roles of planes such as the Tu-16 Badger that can have reconnaissance, bomber, and tanking roles.
 14. International Institute for Strategic Studies, *The Military Balance 1985-1986*. The Soviet Union deploys 270 fighters to its northwestern air defense district. The district, with headquarters in Archangel, has responsibility for the Kola peninsula. These aircraft could be augmented with planes stationed at Leningrad (145 fighter/attack aircraft) or at Kaliningrad (250 fighters).
 15. Soviet Northern Fleet submarine forces total 116, according to the International Institute for Strategic Studies. The Navy's estimate for the area is apparently about 180. Many critics feel that defending against submarines is an even more difficult task for carriers than air defense.

The Navy also argues that positioning the carriers farther away from the Soviet Union would not solve the problem of vulnerability. Even carriers positioned somewhat south of the Greenland-Iceland-United Kingdom gap would still be within bomber range of Soviet land-based aircraft and would be too far away to pose a credible threat to Soviet forces.^{16/} (Although Soviet bombers could indeed attack the carriers at these ranges, they would have to fly unaccompanied by fighters, thus becoming more vulnerable to carrier-based fighters.) Moreover, the Navy argues, a passive defense at the gap gives up substantial flexibility and is, in effect, abandoning Norway to the Soviet forces.

According to some Navy discussions of the maritime strategy, this problem of vulnerability would be solved if carrier attacks occurred after Soviet land-based and submarine-based threats had been destroyed by allied forces (though exactly how this might be done is unclear). At least for the submarine threat, this strategy may be feasible since the Navy, while not always specific about the timing of attacks associated with the forward offensive strategy, appears to assume that carriers would move north behind U.S. attack submarines. The exact allied forces that would destroy Soviet fighters and bombers are even less clearly specified, though the Navy frequently refers to "wearing down" the Soviet forces. This approach may mean a more gradual war of attrition, where attacks on the Soviet mainland would occur only after the carriers fought their way slowly north. While this view of a more paced maritime strategy may answer critics' concerns about the carriers' vulnerability, it is less clear how it jibes with the Navy's stated intent for that strategy: surprising the Soviet Union and diverting its energies from the central front.

16. This area is commonly viewed as a good place to set up a barrier defense against submarines because the characteristics of water depth and location of thermal layers make it a more difficult area for submarines to transit without being detected. Even if staying south of the gap does not prevent the carriers from being in bomber range, it might aid in the antisubmarine warfare mission. Thus, it could be argued that the Navy gives up a natural ASW defense by steaming north of the gap. See Tom Stefanick, *Strategic Antisubmarine Warfare and Naval Strategy* (Lexington, Mass.: Lexington Books, 1987), for an extensive description of the waters in this area (as well as an overall discussion of the ASW mission).

Some analysts have expressed concern that the Soviet Union would view U.S. attacks against its SSBNs as sufficient cause for nuclear escalation, even if the attacks involved conventional munitions.^{17/} The Navy avers that the Soviet Union also plans a war of attrition against U.S. SSBNs in the early stages of a conventional war and thus may not begin to use nuclear weapons.

Critics of aircraft carriers assert that, in addition to being vulnerable, the carriers are too expensive relative to their offensive capability. A modern large-deck carrier and its associated air wing cost about \$9 billion to buy and another \$0.5 billion a year to operate (in constant 1988 dollars). Such a carrier embarks 80 to 90 aircraft, but about 50 are designed to protect the carrier itself and its strike aircraft. Moreover, the payload of many of the roughly 40 strike aircraft may be relatively small or their ranges relatively short if they are not refueled. Ranges might be even more limited if strike aircraft have to be accompanied by carrier-based fighters for protection, since both fighters and strike aircraft might require refueling and tanker assets may be limited.^{18/}

The Navy counters that the United States must pay the price for aircraft carriers because the country cannot depend on having access to air bases in foreign countries. Access could be denied by a neutral country or by a country that has been overrun by enemy forces. The United States might have to take these bases by force. In addition, land bases themselves would be vulnerable, in some cases more vulnerable than carriers because the carrier can move. As for the high cost, it is necessary, the Navy argues, because aircraft carriers may

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17. See Joshua M. Epstein, *The 1988 Defense Budget* (Washington, D.C.: Brookings Institution, 1987), p. 52, for a discussion of potential nuclear escalation associated with forward offensive strategy. That study also suggests that--should the Soviets move to nuclear weapons--the forward-deployed carriers would make tempting targets for nuclear attack.
 18. Concerns about the offensive capabilities of naval aviation also have bearing on the forward offensive strategy. Some critics question whether naval aircraft, even brought within range of the northern Soviet bases, could do much damage. These concerns may be appropriate since many analysts feel that air bases are difficult to keep closed for prolonged periods, and catching planes in the open may require considerable intelligence information. The Navy would argue that carriers may provide the bulk of strike aircraft that could be brought within range at all.

face intense enemy threats and must therefore have extensive defenses.

This study cannot resolve these many issues, though their resolution does govern one's judgment about the desirability of the Administration's plan for naval aircraft and alternatives to it. Instead, the study focuses on alternatives consistent with differing views of the utility of carriers. The Congress has been quite supportive of aircraft carriers. This year, for example, key committees have authorized the initial funds for purchase of two new nuclear aircraft carriers.

Marine Corps Aircraft

Questions have also been raised about aviation forces for the Marine Corps. Specific concerns revolve around the funding required to pursue the Corps' goal of improving its capacity to move troops and equipment rapidly from transport ship to shore. The Marine Corps' strategy of vertical envelopment places emphasis on transporting many of the forces by air.

A key part of this improvement is the development of a new tilt-rotor aircraft designated the V-22. The V-22 can take off or land like a helicopter either from ships or shore bases. Then, in flight, it can flip its rotors forward and achieve the greater speeds characteristic of fixed-wing aircraft. The Marine Corps feels that replacing existing helicopters with the V-22 will give its force flexibility and the ability to survive in the modern battlefield.

Critics question the desirability of such advanced technology, which could entail increased maintenance requirements, in the usually austere Marine Corps. Increasing maintenance requirements in the battlefield conditions of an amphibious assault could hurt performance. Moreover, the high cost of the V-22 has led some people, including the new Secretary of the Navy, to ask whether the program is cost effective. The Secretary, who had also expressed concerns about the potential vulnerability of the V-22 in battlefield conditions, is now supportive of the program, according to press reports. Many critics also question whether the V-22 will actually be bought at the prices assumed by the Marine Corps, especially since the unit cost

assumes procurement by the Army and Air Force. Both of these services may have more pressing requirements when the time comes for V-22 procurement.^{19/}

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19. House Committee on Armed Services, *The V-22 Osprey (Formerly JVX): Is the Case for Tilt Rotor Tilted?*, Staff Study 99-3 (March 1986). This report also questions whether the capabilities planned for the V-22--in particular, speed and range--are needed. Because increasing capabilities drive up costs, the study asked whether a plane with these greater capabilities would mesh well with the rest of the equipment being bought for the landing team. Broadly, the study finds that assault waves will have to be brought in more slowly and from closer ranges than hypothesized in V-22 requirements, because of the capability of other pieces of equipment. The Marine Corps argues that these capabilities will provide additional flexibility that will be needed.

